(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: 0 064 933
A1

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: 82630035.2

(51) Int. Cl.³: D 21 F 3/02

(22) Date of filing: 30.04.82

(30) Priority: 30.04.81 US 258932

(43) Date of publication of application:
17.11.82 Bulletin 82/46

(84) Designated Contracting States:
DE FR GB IT SE

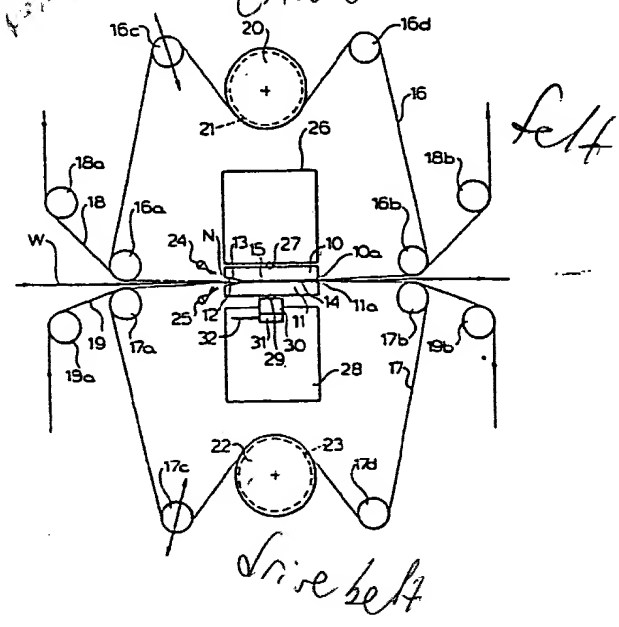
(71) Applicant: BELOIT CORPORATION
Beloit Wisconsin 53511(US)

(72) Inventor: Justus, Edgar J.
1826 Sherwood Drive
Beloit Wisconsin(US)

(74) Representative: Dennemeyer, John James et al,
Office Dennemeyer S.à.r.l. P.O. Box 41
Luxembourg(LU)

(54) Extended nip press.

(57) A pressmechanism for removing water from a traveling fibrous paper web (w) including an elongate extended press nip (N) formed between first and second pressing shoes (10, 11) each having a relieved leading edge (12, 13) with an elongate extending following pressing face (14, 15), felts (18, 19) sandwiching the web in the nip, and traveling impervious belts (16, 17) sandwiching the felt and web therebetween with the belts driven by a grooved traction roll (20, 22) and guide roll, and at least one of the shoes (10, 11) pivotally supported along its length and pressing force being applied to one of the shoes by a piston (30) in a cylinder (31) and pressurized fluid (32) applied to the cylinder and piston to obtain the pressing force



EP 0 064 933 A1

EXTENDED NIP PRESS

The invention relates to an improved method and mechanism for pressing water from a traveling paper web, and more particularly to a press arrangement known as an extended press nip wherein the web is subjected to pressing pressures for a longer period of time than the usual arrangement wherein it passes between two opposed press rolls.

More particularly, the invention relates to a method and structure having a press nip wherein the residence time of the web in the nips is increased over that of a roll couple and wherein an improved structure is used to extract water from a web. Other structures have been provided heretofore which have attempted to increase the time over which a web is subjected to a pressure, and yet permit the web to continue movement at a speed necessary in a high speed papermaking machine. Such structures have met with degrees of success and are exemplified by the disclosures of US Pat. Nos. 3,748,225, Busker et al; 3,783,097, (Re. 30,268), Justus; 3,797,384, Hoff; 3,798,121, Busker et al; 3,804,707, Mohr; 3,808,092, Busker; 3,808,096, Busker et al; 3,840,429, Busker et al; 3,853,698, Mohr; and 4,201,624, Mohr. The devices and method discussed by these previous patents have taken advantage of the knowledge that the static application of mechanical pressure to a wet paper mat can reduce the moisture content in the mat to below 40 %. Under the dynamic short-term mechanical pressing which occurs in the usual paper machine where the web is run between a series of nips formed between press roll couples, it is often difficult to maintain moiture levels below 60 %. Attempts to obtain increased dryness in the conventional roll-couples are usually made by increasing the press nip pressure, but a plateau is soon reached where major increases in roll loading result in relatively small decreases in moisture.

As is known, it is far more efficient to remove water in the press section of a paper machine than in the thermal dryer section and significant reduction in energy costs and significant reduction in the space needed for

the dryer drum section of the machine are achieved for every fraction of a percent of moisture that can be additionally removed in the press section. The difficulty of removing moisture in the press section is increased with increase in machine speed because limiting factores are reached in press nip pressures in that compacting and crushing of the web results with higher nip pressures and resultant higher hydraulic pressures within the paper mat. The most feasible way that has been discovered to increase water removal at high speeds has been to increase the residence or pressure time to allow more time for flow to occur within the paper mat and for the hydraulic pressure to dissipate and for water to be pressed out of the web into the felt.

It is an object of the present invention to utilize the principles of extended nip pressing increasing the time that a web is subjected to pressing pressure and to provide an improved mechanism utilizing opposed shoes in a structure which accommodates relatively high speed travel of a paper web and the application of a pressing force which is controlled to optimum nip pressure for the type of paper being manufactured.

A further object of the invention is to provide an improved extended nip press of a relatively uncomplicated structure which is capable of continued operation over a long period of time without requiring servicing or adjustment or significant attention that would require stopping the machine.

A further object of the invention is to provide an improved extended nip press which has features of being able to obtain uniform pressing pressure across the width of the traveling web for more uniform water removal.

A still further object of the invention is to provide an improved method and structure for an extended nip press which improves the quality of the sheet, improves moisture removal, performs a better pressing operation and reduces rewetting.

A further object of the invention is to provide an improved press nip which employs an extended nip principle

and has an improved structure for driving impervious belts which sandwich the web and felts in the nip.

A feature of the invention provides opposed shoes which define a press nip between them with impervious belts sandwhiching the web and felts passing through the nip, and the shoes having hydraulic films of lubricant and being supported with at least one of the shoes being pivotally mounted so that they assume a hydraulically balanced position accommodating the hydraulic pressure of the film of lubricant which is carried between the shoe and the belt. Pressing force is applied to the nip by a piston and cylinder arrangement supplied with a hydraulic fluid so that the hydraulic fluid acts not only to supply the pressing force, but also insures that this pressing force will be absolutely uniform across the entire width of the press nip. The opposed shoes are sufficiently flexible so that they can bend along their length without introducing forces due to their bending that increase or decrease nip pressure along the shoe length and with the application of nip pressure solely through hydraulic fluid, completely uniform pressure along the full length of the nip can be attained.

Other objects, advantages and features, as well as equivalent structures and methods which are intended to be covered herein, will become more apparent with the teaching of the principles of the invention in connection with the disclosure of the preferred embodiments thereof in the specification, claims and drawings, in which:

The single Figure of the drawings, labelled FIGURE 1 is a somewhat schematic side elevational view of a press section of a papermaking machine ambodying the structure and principles of the present invention.

A nip N for pressing and dewatering a web is formed between first and second shoes 10 and 11. The shoes have a relieved leading edge shown at 12 and 13 leading to a pressing face 14 and 15. The pressing faces each face the extended nip and are smooth and essentially straight so that they apply a pressing pressure to the web W during the time it is passing through the nip.

As will be recognized by those versed in the art, the shoes extend laterally across the web for slightly longer than the web width, and can be referred to as being elongate in the direction transverse of the web travel as indicated by the directional arrow on the web.

The web is sandwiched between felts 18 and 19 which provide means for receiving water pressed from the web, and the felts and web are carried through the nip sandwiched between looped endless impervious belts 16 and 17. The webs guided into the nip and guided away from the nip by suitable guide members, not shown, and the felts are similarly guided into and out of the nip by rolls such as 18a and 18b for the upper felt 18, and rolls 19a and 19b for the lower felt 19.

The looped belts 16 and 17 are made of extremely strong reinforced rubber or similar material, and are driven at the speed of travel of the web so that they carry the web and felts through the nip, and the belts are tensioned on guide rolls shown for the belt 16 at 16a, 16b, 16c and 16d. Roll 16c may be a tension roll movable in the direction of the arrowed lines by suitable tensioning mechanism. The lower belt 17 is guided by similar tensioning rolls 17a, 17b, 17c and 17d, and suitable mechanism is provided for the tension roll 17c to move it in the direction of the arrowed lines for maintaining the desired tension in the belt 17.

An important feature for proper treatment of the web is the means of driving the belts, each of which is wrapped over a grooved traction and guide rolls 20 and 22 for the belts 16 and 17 respectively. The belt is wrapped over these rolls for an arc preferably in excess of 90°, and it has been found that an improved tracking and driving relationship is attained by providing uniform circumferential grooves in the surface of the roll with the grooves shown schematically by the broken lines 21 and 23 for the rolls 20 and 22 respectively. These grooves are annular recesses cut at uniform intervals along the surface of the roll leaving flat land areas therebetween. These grooves apparently permit the escape of any moisture

which may be entrapped between the belt and roll, and permit the belt to depress slightly into the grooves due to its being tensioned to thereby increase the traction between the belt and rolls and also increase the uniformity of drive and guiding relationship. Uniform treatment of the belts is necessary so that the web and felts can be dragged uniformly through the nip.

The grooved traction rolls 20 and 22 engage the outer surface of the belt, which is the surface that is adjacent the felts in the nip. Thus, no driving or traction forces are applied to the inner surface of the belts which surfaces slide over the shoes 10 and 11. Any abrasion caused by the drive is not directed at the sliding surface of the belt. Further, it is to be noted that it is the outer surface of the belt which will be wet from its contact with the felt so that this wetness on the belt surface has been found to be accommodated by the unique grooved traction rolls 20 and 22.

A film of lubricating fluid is continuously developed between the flat surfaces 14 and 15 of the shoes and the belts due to the fact that their leading edges 12 and 13 are relieved and a continuous supply of lubricant is delivered at the location of these relieved edges by jets 24 and 25. The lubricant may be of various substances, such as oil, and is applied in a manner so that each of the shoes acts as a slipper bearing and actually while the shoes press toward each other, the film of lubricating liquid is continuous so that there is a hydraulic transmission of the force of the shoe to the belt through the lubricant. This, of course, reduces the friction between the belt and the shoe, but also provides for a more improved pressing action in that pressure uniformity is enhanced due to the fact that there is a body of liquid between the face of the shoe and the belt, and the liquid must adopt uniform pressure along the elongate length of the shoe.

Because of the hydraulic reaction against the shoe due to the lubricant layer between the shoe and belt, the shoes will tend to tilt to a neutral position. That is,

the shoes are each shown as mounted on a central pivot 27 and 29. These pivots are located approximately midway between the front and back edges of the shoe, and the shoes will operate at a balanced position wherein the hydraulic forces of the lubricant ahead of the pivot are the same as the hydraulic forces behind the pivot.

Edge seals may be provided at the edges of the belt to prevent lubricant from migrating around the edge of the belt, but experience has shown that the amount of lubricant passing around the edge of the belt is minimal so that edge seals are not absolutely essential. The trailing edge of the shoes are rounded slightly at 10a and 11a to reduce the concentration of pressure against the belt as the belts emerge from the trailing edges of the shoes. While each shoe is pivotally mounted by a pivot pin which extends laterally across the entire width of the machine so that the shoe is pivotally supported about its lateral axis, in some instances, it may be desired to pivotally mount only one of the shoes. This will still achieve the hydraulic balance in the nip inasmuch as the one pivoted shoe will pivot to a neutral position with hydraulic forces ahead of and behind the pivot being uniform.

The shoes are supported on opposed heavy beams 26 and 28 above and below the shoes 10 and 11. As referred to above, the pivot pin 27 may be omitted in some instances, and the shoe 10 mounted rigidly on the beam 26, and only the pivot pin 29 provided. This is an alternate structure, but the pivotal support for each of the shoes is preferred. The pivot pins can be so located relative to the leading and traling edge of the shoe so that uniform pressure occurs throughout the length of the extended nip or may be set slightly downstream in the direction of the web movement so that a slightly lower unit nip pressure occurs ahead of the pin than after the pivot pin. The shoes will assume a position of balance wherein the total hydraulic forces of the lubricant in the nip ahead of the pivot pin equal those behind the pivot pin.

For applying the pressure to the shoes to attain the pressing force in the nip, the lower shoe is mounted on a piston 30 seated in a cylinder 31. Hydraulic liquid is delivered to the piston beneath the cylinder by suitable means indicated by the line 32. The cylinder or channel 31 beneath the piston is preferably continuous, or if separated, the same pressure is applied to each of the chambers so that the upward force on the shoe is uniform throughout its length across the machine. If the cylinder or chamber 31 is continuous, since the hydraulic fluid will be at the same pressure throughout the continuous cylinder 31, a uniform upward force will be applied to the shoe throughout its length insuring that the pressing force in the nip will be uniform across the machine. With high nip pressures, the upper beam 26 may bow upwardly slightly in its middle, but the shoes 10 and 11 are sufficiently limber so that they will bow with the beam without introducing any significant forces due to their resistance to bending, and thus the uniform pressure in the nip will not be altered. Similarly, the piston will bow slightly to conform to the bending of the upper beam 26, but the amount of curvature due to this bowing will be insignificant and will not affect the uniformity of pressure in the nip across the machine. If the lower beam 28 bows downwardly, this shape will not be transmitted to the shoes because the sole upward force on the piston is derived from the force of the hydraulic liquid in the cylinder 31 beneath the piston.

In some instances, it may be desirable to support the upper shoe on a piston and cylinder arrangement similar to the piston and cylinder 30 and 31 so that a force is applied both to the upper shoe and to the lower shoe. Or, of course, it will be understood that the lower shoe may be supported directly on a beam on a pivot pin without a piston and cylinder, and the piston and cylinder be provided for the upper beam and upper shoe. If a single piston and cylinder is used, it is preferred that it be used on the lower beam 28, because the weight of the upper beam 26 tends to counteract the

upward reaction force from the shoe 10 applying pressure to the nip.

In operation the two belts 16 and 17 are driven at the speed of travel of the web due to their frictional tracking engagement with their driving rolls 20 and 22. The felts 18 and 19 are carried through the nip with the web between them, and as water is pressed from the web from the time it enters the nip N at the leading edge of the shoes 10 and 11 to where it leaves the shoes, it is received by the felts which are dried in the usual manner. Control of the pressure in the nip is obtained by the pressure of the hydraulic fluid delivered through the line 32 to the cylinder chamber 31. The shoes can be held in loose engagement with the belts at start-up and pressure increased as the machine reaches operating speed, and the pressure adjusted in accordance with the desired operation and the amount of water to be pressed from the web in the extended nip.

The driving rolls drive the belts at uniform speed maintaining constant and uniform traction despite any water which remains on the surface of the belts. It is to be understood that the advantages of the unique driving rolls may be employed in other forms of extended nip presses, such as, for example, structures such as shown in Re 30,268 by forcing a grooved driving roll into driving contact with the outer surface of the belt.

Other forms of structures and modifications of the method falling within the spirit and scope of the invention are intended to be covered herein, and applicant is not limited by the specific preferred embodiment of structure illustrated.

CLAIMS:

1. A press mechanism for removing water from a traveling fibrous web characterized in comprising in combination:

an elongate extended press nip formed between a first pressing shoe at one side of the nip having a relieved leading edge with a following elongate pressing face at one side of the press nip and;

a second pressing shoe at the other side of the press nip having a relieved leading front edge with a following elongate pressing face at the other side of the press nip;

means in the nip for receiving water pressed from the web;

first and second traveling belts passing through the nip between the shoes with said web and water receiving means sandwiched therebetween;

means for delivering lubricant to the leading edge of each of the shoes to develop a hydraulic wedge of lubricant between each of the shoes and the respective belts traveling through the nip; and

means for applying a pressing force to at least one of the shoes urging it toward the nip for applying dewatering pressing force to the web in the nip.

2. A press mechanism for removing water from a traveling fibrous web constructed in accordance with claim 1, characterized in including a pivotal support for at least one of the shoes permitting it to pivot about an axis transverse of the direction of web travel so that the shoe will assume a hydraulically balanced position relative to the lubricant delivered to the leading edge and situated between the belt and shoe.

3. A press mechanism for removing water from a traveling fibrous web constructed in accordance with claim 1, characterized in including first and second pivotal support respectively for said first and second shoes permitting pivotal movement about an axis transverse of the direction of web travel so that the shoes assume a hydraulically balanced position relative to the forces

applied to the faces of the shoe by the lubricant between the shoes and their respective belts.

4. A press mechanism for removing water from a traveling fibrous web constructed in accordance witn claim 1, characterized in that said means for applying the pressing force includes a transversely extending fluid support for one of said shoes applying a force to the shoe which is uniform along the length of the shoe transverse of the direction of web travel so that a uniform force is applied to the web along the nip.

5. A press mechanism for removing water from a traveling fibrous web constructed in accordance with claim 4, characterized in that the fluid support is in the form of a piston and cylinder with the cylinder carried on a relatively rigid support and the piston is supported in the cylinder by pressurized liquid and the cylinder supporting the shoe on a pivot extending transversely of the direction of web travel.

6. A press mechanism for removing water from a traveling fibrous web constructed in accordance with claim 1, characterized in that the water receiving means is in the form of first and second felts positioned adjacent the traveling belts with the web sandwiched between said felts.

7. A press mechanism for removing water from a traveling fibrous web characterized in comprising in combination:

an elongate extended press nip formed between a first pressing shoe at one side of the nip having a relieved front leading edge with a following elongate pressing face at one side of the press nip, and:

a second pressing shoe at the other side of the nip having a relieved leading front edge with a following elongate pressing face at the other side of the press nip;

means guiding a traveling web through said nip for pressing and dewatering the web;

first and second felts sandwiching the web therebetween and passing tnrough the nip;

first and second traveling looped belts passing

through the nip between the shoes with the web and felts sandwiched therebetween;

means for delivering lubricant to the leading edge of each of the shoes to develop a hydraulic wedge of lubricant between the shoes and their respective belts;

guide and tension rolls for each of the belts including a traction drive roll having annular grooves therein with the belts wrapped over the traction roll in driven relationship thereto;

pivotal supports for each of the shoes supporting the shoes for pivotal movement about an axis transverse to the direction of web movement;

a relatively rigid support beam means supporting the fist shoe on its pivotal support;

a relatively rigid second support beam means for the second shoe;

a cylinder in the second beam with an elongate piston means in the cylinder with the cylinder and piston extending transversely along the shoe and supporting the shoe pivotally on the piston; and

means for delivering a pressurized fluid to the cylinder for applying a pressing force to the second shoe and providing a pressing force to the web in the nip uniformly across the length of the nip.

8. A press mechanism for removing water from a traveling fibrous web characterized in comprising in combination:

an elongate extended press nip formed between a first pressing shoe at one side of the nip having an elongate pressing face at one side of the nip, and;

a second pressing shoe at the other side of the nip having an elongate pressing face facing the press nip;

means passing through the nip with the web for receiving water pressed from the web;

first and second traveling belts passing through the nip sandwiching the web and water receiving means therebetween;

means for applying a pressing force for urging the shoes together to apply a pressure to the web in the nip;

means for pivotally supporting at least one of the

shoes about an axis extending transversely of the direction of travel of the web; and

means for providing a film of lubricating fluid between each of the shoes and each of the belts.

9. A press mechanism for removing water from a traveling fibrous web characterized in comprising in combination:

an elongate extended press nip formed between first and second opposed pressing elements having elongate pressing faces facing the nip for applying a pressing force to a traveling fibrous web moving through the nip;

means in the nip for receiving water pressed from the web;

first and second traveling looped belts passing through the nips between said faces with the web and water receiving means sandwiched therebetween; and

guide and tensioning rolls within each of the belts including a drive roll for each of the belts with the belts wrapped over the surface of the respective drive rolls,

said drive rolls each having circumferential grooves over the surface for traction and guidance of the belts.

10. The method of pressing water from a traveling fibrous web characterized in comprising the steps:

passing the web through an elongate extended press nip formed between first and second pressing shoes having extended faces facing the press nip;

passing first and second traveling belts through the nip with the web sandwiched between the belts;

passing means through the nip for receiving water pressed from the web;

Pivotally supporting at least one of the shoes; and generating a film of liquid lubricant between each of the shoes and their respective belts so that the pivoted shoe will pivot to a position of hydraulic balance relative to the films of lubricant between the belts and shoes.

11. The method of pressing water from a traveling web in accordance with the steps of claim 10, characterized in that the film of lubricant is generated by delivering a supply of lubricating liquid to the leading edge of each

of the shoes and to develop a hydraulic wedge of lubricant along the face of the shoes.

12. The method of pressing water from a traveling web in accordance with the steps of claim 10, characterized in including supporting at least one of the shoes on a support containing a liquid support chamber extending along the length of the shoe across the traveling web for obtaining uniform nip pressure across the nip.

13. An extended nip press for removing water from a traveling fibrous web characterized in comprising in combination:

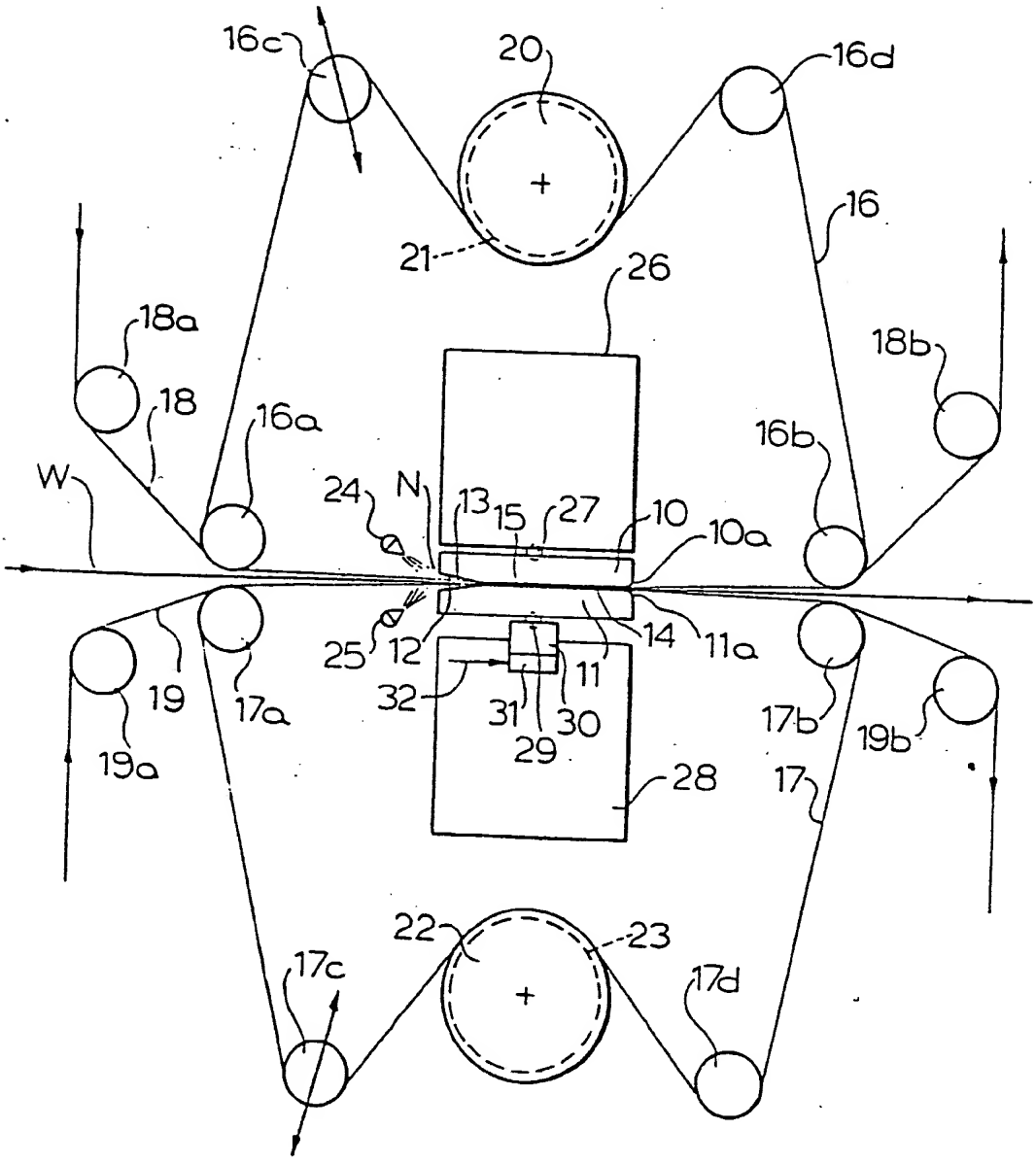
first and second looped nonporous flexible belts positioned in a nip defining relationship with each other;

guide means within the belts guiding the travel of the belts to form said nip;

first and second shoes on opposite sides of the nip outside of the belts applying a pressing force to the nip through the belts;

means for developing a layer of hydraulic lubricating fluid between the shoes and the belts; and

a deflection control means for one of said shoes including a fluid pressure backing chamber means applying a force to the shoe toward the nip and extending laterally of the direction of belt travel and applying a fluid pressure backing at a uniform force along the nip.


16c
20
16d
16
21
26
18a
18b
18
16a
16b
W
24
N
13
15
27
10
10a
25
12
14
11a
11
32
31
30
29
28
19
17a
17b
19b
19a
17
22
23
17c
17d

European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 82 63 0035

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
A	GB-A-2 057 027 (APPLICANT'S NAME) *The whole document* ---	1-13	D 21 F 3/02
D,A	US-A-3 748 225 (BUSKER et al.) *The whole document* -----	1,4-13	

TECHNICAL FIELDS SEARCHED (Int. Cl. ³)

D 21 F
B 30 B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	06-08-1982	DE RIJCK F.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO Form 1503. 03.82